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UNIVERSITY OF MARYLAND
UNIVERSITY COLLEGE
GRADUATE SCHOOL
OF
MANAGEMENT & TECHNOLOGY
MANAGEMENT PROJECT

TECHNOLOGY MANAGEMENT

ANALYSIS OF THE ARMY'S
INSTALLATION SUPPORT MODULES WITH THE PRIVATE SECTOR'S
OPEN INFORMATION SYSTEMS

FINAL REPORT

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APRIL 9, 1993

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2. As outlined in the above paragraph, the undersigned
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ACKNOWLEDGEMENTS

The author wishes to express deep appreciation to his graduate advisor, Dr. J. Spigai, and Dr. J. West for their advice and feedback during the preparation of this report. Also, the author wishes to thank Tony Cavallo and LTC H. Hagans for the their expertise and suggestions in the preparation of this report. Finally and foremost, the author wishes to thank the Heavenly Father for providing him with the opportunity to complete this report.

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TABLE OF CONTENTS

| | |
|---|-----|
| Title Page..... | i |
| Acknowledgements..... | ii |
| Table of Contents..... | iii |
| Abstract..... | v |
| Introduction..... | 1 |
| Statement of the Project's Purpose..... | 1 |
| Discussion of the Problem..... | 2 |
| Literature Review/Discussion..... | 8 |
| Statement of Approach/Methodology..... | 20 |
| Limitations of the Study..... | 26 |
| Data Analysis and Results..... | 28 |
| Findings of the Study..... | 37 |
| Recommendations for Implementation..... | 40 |
| Implementation Plan..... | 41 |
| Final Summary and Evaluation..... | 45 |
| References..... | 48 |
| Bibliography..... | 49 |

Table of Contents (Con't)

Appendices:

| | | |
|-------------|--|----|
| Appendix A: | Standard Installation Organization Diagram | 51 |
| Appendix B: | Cover Letter, Definition Sheet and Questionnaire..... | 52 |
| Appendix C: | List of Surveyed Companies and Director of Information Management (DOIM's)..... | 60 |
| Appendix D: | Survey Results of Open & Proprietary IS users..... | 63 |
| Appendix E: | Survey Results of IS users (CCS, OSF, & X/OPEN)..... | 64 |
| Appendix F: | Survey Results of Industries Surveyed..... | 65 |
| Appendix G: | Questionnaire Responses from the Proprietary IS users..... | 66 |
| Appendix H: | Questionnaire Responses from the Private Sector's Open IS users..... | 67 |
| Appendix I: | Questionnaire Responses from the DOIM's with ISM's..... | 68 |
| Appendix J: | Human Subjects Involved in the Study..... | 69 |

Attachments:

| | | |
|---------------|---|----|
| Attachment A: | Management Project Assessment Form..... | 70 |
| Attachment B: | Management Project Approval Sheet..... | 71 |

ABSTRACT

Installation management within the U.S. Army is comprised of a myriad of basic management functions such as real property acquisition and personnel accountability. These functions are performed by installation organizations which are responsible for managing the manpower, funds, and equipment assigned to the installation during peace and wartime conditions. Each installation organization uses an information system tailored to its specific mission to perform daily tasks. However, this network configuration is characterized by the lack of data sharing capability and it does not promote qualitative management of military resources. In order to incorporate data sharing among the installation organizations and enhance installation management, the Army has developed a new information system called Installation Support Modules (ISM). The ISM is a computer hardware, software, and communications infrastructure designed to provide installation organizations with the capability of horizontal and vertical data sharing. The Army's acquisition strategy for the ISM is to develop the system with the latest computer and information technology, Open Systems Environment (OSE). However, the risk associated with OSE technology is that open systems is

a rapidly changing and complex environment since its standards will be dictated by Information System (IS) users and not vendors. IS users who are conducting research to influence the development of open systems standards are considered as forerunners in OSE technology. These IS users are likely to receive maximum benefit of the standards once they are developed. Other users such as the Army who are not forerunners in OSE technology are likely to receive minimum benefit from the standards. In regards to this shortcoming, it is highly possible that once the ISM is fielded, its components may be out-dated or not compatible with the private sector's standard OSE information system. Thus, this report identifies the comparable posture of the ISM with the private sector standard OSE information system.

The study consisted of a literature search, data collection, and data analysis. These activities provided the writer with detailed information to compare the ISM with the industry standard open information system. Data collected by surveying 49 companies in the private sector and four military installations indicated that the overall posture of ISM lagged the private sector information system in OSE technology. Findings indicated that the ISM lagged

the private sector's system in interoperability, portability, and availability.

Recommendations concerning interoperability, portability, and availability were provided to the Army to improve ISM posture in OSE technology. Also, a recommendation concerning scalability to assist the Army in maximizing this feature within the ISM acquisition strategy was provided. The rank order for implementing these recommendations were interoperability, portability, scalability, and availability.

This study was clearly exploratory and had three limitations: (1) survey selection method, (2) sample size of the ISM, and (3) the method for selecting participants in the brainstorming session to develop recommendations. In regards to these limitations, the recommendations of this study should be used as a basis for additional research. Additional research could involve a much larger sample to better represent the population of IS users. Until additional research is completed, the recommendations of this study should be used as a guide to complete the developmental phase of the ISM.

**Analysis of the Army's
Installation Support Modules with the Private Sector's
Information Management Systems**

INTRODUCTION

This management project describes the comparable posture of the Army's newest information system, Installation Support Modules (ISM), with the industry standard information system that operates in an Open Systems Environment (OSE).

Statement of the Project's Purpose

The purpose of this management project is to provide the Army with a comparative analysis of the ISM against the industry standard OSE information system. The objective of the project is to provide recommendations that will influence the ISM implementation strategy and ensure that the system will maximize the benefits of OSE technology. The implementation of the recommendations could result with a system that is efficiently managed from the development to the deterioration phase of the system life cycle process. The result of this opportunity would enable the Army to streamline the methods in which it manages resources on military installations.

The comparative analysis of the ISM architectural structure with the private sector's standard for information management is extremely important during the development phase. It will identify the comparable posture of the ISM with the private sector's standard OSE information system. Any shortcoming discovered in the ISM during this phase can be modified with the latest computer technology innovation prior to fielding. However, if the ISM is fielded with out-dated technology, the Army will waste an enormous amount of resources by fielding an antiquated system.

It is estimated that ISM could save the Army significant resources in installation management. If ISM is fielded with current OSE technology, the Army can realized a greater availability of hardware and software products with improved performance and price to enhance data sharing and reduce information technology costs. However, if ISM is not fielded with current OSE technology, the Army will forfeit the opportunity to increase potential savings and efficiency in installation management.

Discussion of the Problem

Background. The management of the Department of Defense (DOD) resources on military installations within the U.S.

Army is composed of a myriad of basic management functions. These functions are defined as support missions (real property acquisition, personnel accountability, etc.) that must be accomplished daily on installations to maintain an effective combat readiness posture throughout the Army. The support missions are performed by the installation's organizations (i.e. Directorate of Acquisition, Directorate of Personnel and Community Activities, etc.) which are responsible for managing the manpower, funds, and equipment/material assigned to the installation during peacetime, mobilization, and wartime conditions. A standard installation organizational diagram depicting the various installation organizations is shown on Appendix A (Installation Support Modules-Test and Evaluation Master Plan [ISM-TEMP], 1992).

Currently, each installation organization utilizes a local area network (LAN) tailored to its specific support mission as an information system for performing daily tasks. However, this technique does not support the present or projected additional workloads for the organizations. The current network is characterized by the lack of information sharing capability among the organizations which does not promote qualitative management

of DOD resources. Further, the lack of shared information has frequently resulted in the organizations using obsolete and untimely information to manage resources.

In order to incorporate information sharing among the organizations, their information systems must be horizontally integrated with access to common data. The means for accomplishing this task is to organize the common information needs of the organizations into an integrated information capability. An information system with this capability will promote Total Quality Management (TQM) in the organizations ability to manage their support mission and eliminate tailored-functional systems.

Recently, the Director of Management, Office of The Chief of Staff of the Army, approved a project to enhance installation management, Army-wide, through the implementation of the Installation Support Modules (ISM) system. ISM is a computer hardware, software, and communications infrastructure designed to provide organizations with an integrated information management capability. Also, ISM will provide organizations with the capability of horizontal and vertical information sharing.

It is important to understand that ISM is presently in the developmental phase of the project life cycle.

The focus during this phase is to develop the ISM with a functional application software system for operating in an Open System Environment (OSE). ISM will also be comprised of modulate hardware with plug-in/pull-out capability that conforms to OSE standards and guidelines. This feature will facilitate the insertion of new technology and provide a modular growth in data process and communications to meet current and future requirements in installation management. The OSE infrastructure will be designed and developed in accordance with the Federal Application Portability Profile (FAPP), Government Open Systems Interconnections Profile (GOSIP), and the Army's Information Architecture (AIA) model.

Description of the Problem. Currently, the Army is undergoing the most extensive modernization effort in its history for installation management. The mission of ISM is to enhance installation management by providing installation organizations with the capability to share information across functional areas. This system contains the components of recent innovation in computer and information technologies for migrating to an OSE. The DMR Group (1990) states that the OSE phenomenon will create a restructure of information technology and a new era of

opportunity and risk for Information System (IS) users. The era of opportunity will allow IS users to use computers without being concerned about the issues of technology or compatibility. However, the risk associated with OSE is that this technology may become a rapidly changing and complex environment since the standards will be dictated by IS users and not vendors.

For incorporating a standard that will represent everyone interest, some IS users will receive maximum benefits while others will receive minimum benefits. IS users who are members of either the Corporation for Open Systems (COS), Open Systems Foundation (OSF), or X/Open Incorporation are likely to receive the maximum benefit of the standards. The basis for this perception is that companies within these organizations are the forerunners in the private sector who are conducting research to influence the development of an industry standard (Alperin & St. Germain, 1989). IS users who are not forerunners in OSE, such as the Army, may have to accept "less than maximum benefits" from the standards. Therefore, this drawback could cause ISM to be inferior to the private sector since the forerunners will dictate the standards for open systems technology. The effect of this drawback could

result in the ISM with the inability to utilize advanced features of OSE (i.e. scalability, portability, etc.) to support the Army's goal for streamlining installation management.

Another drawback that may cause the ISM to be inferior to the private sector is the lengthy developmental time for producing advanced technology products. Giammo (1993) states that the government procurement cycle is getting slower while the technology cycle of computer products is speeding up. The long developmental time is frequently accredited to limited resources and rigid procedures of the government procurement process. The shortcoming for limited resources exists because Congress and DOD have reduced the defense budget. Furthermore, limited resources have resulted in Congress to cut back, defund, cancel, and later reinstate funds for certain defense projects (Correll & Nash, 1991). The effect of the long development cycle can prevent the government to achieve cost-effective products from its procurement process (Williamson, 1993).

Gansler (1989) states that the government loses a significant amount of technological superiority because its material requires a longer period to acquire than similar commercial products. Williamson (1993) states that it is

ridiculous that the government takes three years to complete a major procurement while in private industry such procurement can be completed in weeks or days. The rationale for this drawback is that the DOD procurement process is standardized with inflexible regulations and procedures to prevent waste, fraud, and abuse. In regards to these drawbacks, it is highly possible that once ISM is fielded, its components could be out-dated or not compatible with the private's sector standard for OSE information systems.

LITERATURE REVIEW/DISCUSSION

Discussion. The literature review did not reveal any significant information concerning the problem of the ISM being inferior to the Private Sector standard OSE information system. However, the review provide a wealth of background information about OSE technology and the benefits and drawbacks associated with the migration to open systems.

LITERATURE REVIEW

Open Systems Environment (OSE) encompasses the functions needed to provide interoperability, portability, scalability, and availability of computerized applications across networks of heterogeneous hardware and software

platforms. OSE forms a framework that allows interfaces, services, protocols, and supporting data formats to be defined in terms of non-proprietary specifications. Runyan (1989) believes that open systems will provide new business opportunities through a more economical method of flexible computer technology for Information Systems (IS) users. However, in this rapidly changing environment for computers, technology is evolving faster than IS users can produce and implement new information management systems. In regards to such shortcoming, the goal of this research is to identify and discuss key issues that are associated with implementing an information management system with OSE technology.

The definition of an open system has several variations among different IS users. Burgetz (1991) defined an open system as a "vendor-independent computing environment consisting of commonly available computer products that have been designed and implemented in accordance with accepted non-proprietary standards" (p. 27). Mills (1990) identified an open system as a method for achieving interoperability within multi-vendor networks. Further, an open system can be interpreted as a computer or network system in which any hardware, software,

or the combination of both, can be designed to a functional specification (General Motors, 1990).

The demand for open systems was generated by IS users because they wanted complete freedom to communicate with one another without any operational drawback concerning their computer system or technicalities associated with data communication. In response to this demand, the International Organization for Standardization (ISO) and International Consultative Committee for Telegraph and Telecommunications (CCITT) developed a set of common standards regarding the interconnection and interworking functions of a computer system. These standards were designed to create interoperability for computers communicating in the same network. The ISO and CCITT standards are referred to as the Open System Interconnections (OSI) basic reference model. Alperin and St. Germain (1989) stated that the purpose of the OSI model is to provide a standard for incorporating interoperability among different computer systems. Duffy (1989) stated that the OSI model is a guide for promoting a standard in data communication. With a data communication standard, computer systems built by different vendors can exchange data effortlessly. Nance (1991) believes that the OSI

model is critical because it provides the framework that developers must use to produce interoperable products.

The OSI model is a description of the network architecture for a computer system's various physical, electrical, communication, and application functions. These functions are organized as a hierarchy of seven functional groups called layers. According to Nance (1991), each layer presents a defined interface to the adjacent layers, permitting hardware from different vendors to interact seamlessly.

The seven functional layers are: physical, data link, network, transport, session, presentation, and application, respectively, layers 1 through 7. Layers 1 through 4 relate to interconnection (transport of data) aspects while layers 5 through 7 pertain to the functions of interworking (information presented in an understandable form). The Government Open System Interconnection Profile (GOSIP) (1991) states that as long as the information that passes between the computer conforms to the OSI model, data can be interpreted upon receipt and communication is possible.

The physical layer is the lowest of the OSI model. It specifies the physical and electrical characteristics of the connection that comprise a network. Also, the physical

layer encompasses the transmission media for the data which are: twisted-pair, fiber optics and coaxial cables, connectors, and repeaters. The transmission media facilitates the transmission of data bits from one computer system to another.

The data link layer, functionally, is the most complex of the seven layers. It converts the data bit into data packets (messages) and provides error detection and correction. Due to its complexity, the data link layer is divided into two sub-layers called the Media Access Control (MAC) and Logical Link Control (LLC). The MAC manages network access (bit patterns and encoding methods) and network control. The LLC transmits and receives the data packets.

The network layer provides data routing and relaying between computer systems. It is responsible for addressing and delivering packets.

The transport layer allows the data packets to move freely between computer systems. However, when more than one packet is in process at any one time, this layer controls the sequencing of the packets and regulates inbound data traffic.

The session layer allows the exchange of messages

between two computer workstations. This layer enables applications that are running between two workstations to coordinate their communication in a form of dialogue. During the dialogue, the session layer will transmits a message to one workstation if another has terminated communication.

The presentation layer ensures that the data is transmitted in a form which the receiving computer can interpret, usually ASCII. For instances, if two IS users wanted to communicate using different computers, a translation to understand the content and meaning of the data must occur among the computers. Accordingly, the presentation layer transforms the data from the application into a form that can be recognized and interpreted by both computers (GOSIP, 1991).

The application layer, the only part of the process that the user observes, converts the readable characters of the application to data bits. When data is transmitted across a network, it enters the OSI protocol at this layer. Next, the message is processed between layers 6 and 2 and transmitted to the receiving computer at layer 1. Once the data arrives at layer 1 of the receiving computer, it enters the OSI protocol. Next, the data is processed

between layers 2 and 6 and transmitted to the application layer for interpretation into the appropriate application (Watts, 1991).

Burgetz (1991) believes that open systems promises to create an environment with portability, interoperability, scalability, and availability. An OSE extends the OSI concept and pertains to the broader issues of application, portability, and interoperability. These issues address five fundamental areas: management, and user interface services, operating services, information services, and communications services.

OSE is expected to drastically alter the workplace of IS users in the 1990's. From a management prospective, IS users view OSE as the technique to reduce operating and equipment costs. Johnson (1987) states that "since the market demand for computers has shifted to open systems, vendors must produce computer products with a common protocol" (p. 40). With a common protocol, IS users will not have to expend resources (manpower and money) for writing software interfaces to communicate with different computers. The Installation Support Modules (ISM) Project Summary (1992), states that equipment costs will be significant reduced because OSE promotes competition.

Therefore, hardware and software products will be purchased from a competitive free market of vendors.

User interface services provides IS users with the capability to interact with applications (Federal Application Portability Profile [FAPP], 1991). IS users want the capability to operate computers with user interfaces (i.e. mouse, graphic symbols, etc.) without the need to learn a new operating environment. Satisfying this demand would reduce the time required to learn specific commands and syntax. With the market shifting to OSE, several leading developers are conducting research to produce an OSI standard Graphical User Interface (GUI) application for operating systems. Levin (1992) states that GUI's are icons (graphic representation of a file, storage device, etc.) or hardware peripherals that offer an easy-to-use capability for learning operating systems such as MS DOS or UNIX. By incorporating GUI's into OSE, developers will provide IS users with a standard method for operating computers.

Cashin (1991) states that the operating services controls the components of the computer and provides an interface between the application and hardware. The operating system manages high-level software such as

languages, applications, and drives the hardware. However, there is a drawback concerning the interface capability between various operating systems and application software products. The drawback is that many software products are not portable (the capability of a software product to be transferred from one hardware or software environment to another). Gray (1991) states that many applications that can run on one computer will not operate on an identical hardware product using a different operating system software unless the application is modified.

With OSE, application and operating system software products will be standardized by the Portable Operating System Interface for Computer Environment (POSIX). POSIX, developed by the Institute of Electrical and Electronics Engineers (IEEE), is a set of standard interfaces that uses OSI protocols for software products. Through POSIX, both application and operating system software products will be developed with an interface capability regardless of the vendor.

Kuhn (1991) defines information services as data management and data interchange functions of a computer. Data management is the portion of the operating system which performs the functions to create, process, and

administer data. Data management functions are: data dictionary, database management, and data management security. Data interchange functions are specialized support for interchanging data between applications. Data interchange functions are: document, product data interchange, and data interchange security.

According to Holmes (1988), the healthcare industry has adapted to open systems to enhance data exchange in hospitals. With the implementation of the Medical Data Interchange (MEDIX) information system, hospitals have saved money and enhanced patient care by reducing man-hours for processing information. In the past, when an individual was admitted to a hospital, the patient personal data was entered in Admission and each subsequent department (i.e. radiology, pharmacy, etc.) information system where he received medical treatment. This procedure was necessary because the hospital systems were not interoperable. Also, manpower was wasted and the potential for inputting erroneous data existed with each subsequent input. Today, productivity at hospitals with MEDIX has increased because information is readily available to every department that needs access to a patient record.

The communications services enable data sharing of

applications that are running on various computers in a network. The communications services are: personal computer support, data communications, and transparent file access (FAPP, 1991). Lilegdon, as quoted by Sheridan and Tersesko (1991), stated that "communicating in an OSE can eliminate the need to log onto one computer to obtain certain information, then sign off, and log onto another to retrieve different information" (p. 33).

Implementing an open system has demonstrated that IS users will have significant benefits, however, there are two shortcomings associated with OSE. The shortcomings are security and migration costs.

Portability, interoperability, scalability, and information sharing should be balanced with security requirements. However, these elements are not always balanced properly and security breaches result. The most common violations of security are listed below.

1. Porting uncertified software that may be infested with a virus.
2. Sending private or sensitive information across the computer network without necessary precautions, such as encryption.
3. Providing weak protection for computers and

networks from the spread of viruses.

Firdman (1991) stated that security has been a low priority in the technological development of open systems. During a recent survey of IS users who owned computers that operated in an OSE, security was not even mentioned as a problem. However, placing emphasis on security as a major IS design consideration can enhance IS users awareness and generate a demand to develop OSE security services.

Bonstein (1991) estimates that the cost of migrating a computer system to operate in an OSE can be significantly more expensive than the traditional approach for data sharing (point-to-point). Also, the migration to OSE is likely to have no immediate business benefits because it is considered as an investment for the future. If an organization decides to migrate to open systems, an expenditure of resources for retraining personnel and porting existing applications to OSE technology will be required. Therefore, with this shortcoming, it is possible that management may reject any proposal for procuring OSI products to replace the organization's existing system.

Today, many IS users are expending approximately 80% of their time acquiring data. Therefore, only 20% of their time is used for data analysis (Sheridan & Teresko, 1991).

However, in an OSE, this ratio will shift and IS users will expend 80% of their time analyzing and manipulating data into information. This is one of the many benefits of open systems since it is the vehicle for providing IS users with horizontal and vertical data sharing. However, to realize the benefits of open systems while minimizing the drawbacks, it is essential that IS users have a clear view of their business objectives and goals and follow sound implementation techniques.

STATEMENT OF APPROACH/METHODOLOGY

Three methods were used to obtain the information required for a sound research conclusion. The methods were: literature search, data collection, and data analysis.

The first step of the research was to perform a literature search concerning the problem area. The literature search identified information that had been researched in the field of information and computer technologies. It provided background information about OSE technology and supply additional sources concerning the study. Further, the search identified advantages and disadvantages for IS users to migrate to OSE technology.

The second step was to collect data for evaluating the

ISM and the private sector's standard information system that comply with the OSE standards. Each system was evaluated according to its conformance to the OSE standards by four key elements. The elements used to evaluate the systems were portability, interoperability, scalability, and availability.

Portability is defined as the ability to use application software on various computers that are supplied from multiple vendors (DMR Group, 1990). Portability was used to measure whether the same application could operate on computer platforms supplied by different vendors. Through portability, an application can be transferred from one architecture to another without any software modifications.

Interoperability is defined as ability to have computers that are supplied by different vendors to operate together in a network (DMR Group, 1990). Interoperability was used to measure data communications among multiple vendors' computer systems in the same network using a software application for data processing and sharing. With interoperability, data communication between different vendors' platforms will cease to be an issue within information and computer technologies.

Scalability is defined as the capability to use the same software environment on many classes of computers, ranging from personal computers to super computers (DMR Group, 1990). Scalability was used to measure whether data communications can exist in a network when the software application is transferred from a small computer to a mega-size computer or vice versa. With scalability, the software application investment is not wasted with an upgrade to a larger or smaller computer.

Availability is defined as the capability to acquire hardware and software for a computer system within the marketplace (Burgetz, 1991). Availability was used to measure how accessible are the hardware and software products on the market for the computer system. Through availability, IS users are not restricted to a single source of supply. Further, since computer hardware and software products are commodities, IS users can make acquisition decisions based primarily on price.

The data collection method for evaluating ISM and the private sector's information systems was conducted by surveys. The survey instrument was designed to collect information concerning the strategies in which the Army and the private sector are using to implement their

information systems in an OSE. The data for designing the survey instrument was comprised of information that was discovered during an exploration (literature search) of OSE technology.

The primary survey method was mail survey. Mail surveys were inexpensive and contact with respondents, who were unavailable or inaccessible during work hours, was possible. However, the major shortcoming for the mail survey method was non-response. As an alternative means of data collection, occasionally, personal and telephone interviews were conducted when the mail survey was unsuccessful.

The survey instrument used was a questionnaire. Each questionnaire was accompanied with a cover letter and definition sheet (see Appendix B). The cover letter and definition sheet identified the purpose of the survey and terms frequently used in the questionnaire. The key sections of the questionnaire were: Portability, Interoperability, Scalability, and Availability. Each section addressed issues concerning an information system conformance to OSE. The response method for majority of the questions was a five-point (Likert) rating scale. There were three open-ended questions to allow respondents

the freedom to address areas which were not mentioned on the questionnaire.

The response to each question was analyzed by using a data collection matrix. West (1992) cited that the matrix is a data collection instrument used to record the frequency of a response for data interpretation. Also, a pilot test was conducted to assess the validity, clarity, structure, and length of the questionnaire. Several pilot tests were conducted by the Corporation of Open Systems (COS), X/Open Incorporated (X/OPEN), Program Executive Office - Standard Army Management Information Systems (PEO-STAMIS), and the Graduate School of Management and Technology, University of Maryland, University College.

In surveying the Army's information management system, data was collected from the prototype systems that are located on various military installations. The sampling technique for selecting the system to survey was systematic sampling. This technique provided an efficient, statistical sampling since this population was comprised of similar elements. After the data was collected, it was analyzed and structured as one entity for comparing the ISM with the private sector.

For surveying the private sector, data was collected

from companies that were migrating to OSE technology and were members in either the (COS), X/Open, or Open Systems Foundation (OSF) organizations. It was important to survey companies in these organizations because they are the forerunners who are conducting research to influence the development of an industry OSE standard. Also, companies that are not members of these organizations and are migrating to OSE technology were surveyed.

The technique for selecting companies to survey was stratified sampling. Stratified sampling provided an efficient, statistical sampling for analyzing the various sub-populations. Also, stratified sampling minimized the bias and preferences that were encountered during the survey. Upon the completion of data collection, the data was analyzed and structured as one entity for comparing the private sector with the Army.

The third step was to analyze all the collected data for interpretation. The four key elements (portability, interoperability, scalability, and availability) of OSE were used to determine the comparable posture between ISM and the private sector's standard information system. Comparison of each system was performed by using statistical analysis (mean score) per statement to identify

which system was superior.

Upon the completion of the data analysis, the top survey problems were selected as a result from the statistical analysis. Three recommendations were selected for solving the problem area. Each recommendation was developed by performing a brainstorming session consisting of personnel from the ISM project office and various companies that participated in the survey and are migrating to OSE technology. The brainstorming session was selected because it promoted creativity in problem-solving to produce constructive solutions to problems (Fisher & Ury, 1991).

Finally, the criteria of success for these recommendations are information sharing, manpower, training, manhours, and reduced operating cost. These criteria will be the measurement factors to determine if the recommendations for the ISM produce successful results.

LIMITATIONS OF THE STUDY

The limitations of this study were: survey selection method, ISM sampling size, and the selection of participants to brainstorm the solutions to the problem area. The first limitation was the survey selection methods. The survey selection method for the private

sector was stratification. By using this method, the entire population was not represented thoroughly to establish a sound industry standard for OSE. Also, the ISM encountered a similar shortcoming in representation since the data was collected from a few military installations where the system has been installed.

The second limitation was the sampling size for the ISM. Since ISM was still in the development phase, there were only a few systems available for sampling. Therefore, the ISM sampling size was small and the validity of the Army's responses could be questionable. However, according to Bryman, it is possible to use a small sample and still maintain a high degree of validity as long as the sampling size represents a homogeneous population. For this study, the sample size of the Army was homogeneous and each respondent was familiar with the problem area. Thus, most of the validity concerns were minimized.

The third limitation was the selection of participants to brainstorm the solutions for the problem area. The participants were personnel that were willing to partake in the session. Since there was not maximum participation among the companies, the opportunity to maximize ideas from the forerunners in OSE technology to solve the problems was

not afforded. To minimize this drawback, the writer was able to obtain representation from some of the companies that were members of COS, X/OPEN, and OSF organizations and/or experienced in the defense contracting process.

DATA ANALYSIS AND RESULTS

Data from the survey was analyzed in various methods. Appendix C identifies the list of companies and military installations that participated in the survey. Appendices D and E illustrate general information concerning the companies that participated in the survey. Appendix D identifies the percentages of the surveyed companies that are either migrating to OSE technology or remaining with proprietary systems. Further, Appendix E identifies the percentage of surveyed companies that are members of COS, X/OPEN, and/or OSF organizations. Appendix F illustrates the type of business/industries conducted by the companies.

Data analysis of the empirical study is illustrated in Appendices G, H, and I. Appendix G illustrates the responses from companies that were not migrating to OSE technology (Proprietary systems). Appendix H illustrates the responses from companies that were migrating to OSE

technology. Appendix I illustrates the responses from the Directorates of Information Management (DOIM's) of the military installations where the ISM has been installed.

The study population consisted of information technology decision-makers from companies in the private sector and the Army's DOIM's. Of this population, the writer sampled 101 companies in the private sector and six DOIM's in the Army. The survey total response rate comprised of both the Army and private sector was 49.5%. The individual response rate from both the Army and private sector was 66.6% and 48.51%, respectively. Within the private sector, thirty nine (80%) of the surveyed companies were migrating to OSE technology (see Appendix D). The remaining ten (20%) companies were not migrating to OSE technology (Proprietary IS users). Also, fifteen (38%) of the companies that were migrating to OSE were members of either COS, X/OPEN, or OSF organizations (see Appendix E).

Companies in the Private Sector with Proprietary Information Systems. The data from Appendix G reveals that the companies with proprietary information systems are currently obtaining similar benefits in computer and information technologies as the companies with OSE information systems (Appendix H). However, proprietary

systems scores are similar to those of OSE systems because open systems standards are still within the developmental stage. Once the standards are developed, it is expected that information systems that operate in an OSE should far exceed the benefits of improved price and performance over the proprietary systems (DMR Group, 1990).

Companies in the Private Sector with OSE Information

Systems and the ISM. The data in Appendix H and I identify the responses of the companies with OSE information systems and the DOIM's where the ISM has been installed, respectively. For observational purposes concerning only the private sector, the writer separated the non-leaders and forerunners of OSE technology data to identify their mean scores separately (see Appendix H). According to Alperin and St. Germain, companies in COS, X/OPEN, and OSF organizations are the leaders of OSE technology. Therefore, it is expected that the forerunners' scores would be higher than the non-leaders. However, the data indicates that the forerunners' highest score difference over the non-leaders is .56 (3.6 - 3.04) in Section 3, statement D, of the questionnaire. Further, in Section 2, the non-leaders mean score for each statement is higher than the forerunners in OSE technology. The data for

Section 2 is an indication that the non-leaders with OSE information systems value the benefits of improved price and performance of hardware and software products more than the forerunners. The MCI Corporation (Arlington, VA) stated that the forerunners' scores are not significantly higher than the non-leaders because the forerunners' top priority is to compete among each other by conducting research to influence the development of OSE standards. Thus, once the standards are developed, the forerunners' information systems performance should significantly lead the non-leaders.

In analyzing both the private sector (forerunners and non-leaders of OSE technology) and the Army (DOIM's 1, 2, 3, & 4), the writer began the data analysis by compiling the data in tables. Each key section of the questionnaire was analyzed by using the format of Table 1. Column one depicts the letter of the statement for each section. Column two contains the statements used in the questionnaire for each section. Columns three and four are the mean scores per statement for both the private sector and ISM, respectively. The mean scores for each statement are also listed in Appendices H and I for both the Private Sector and ISM, respectively.

| Statement | Description of the Statement | Private | ISM |
|-----------|--|---------|------|
| A | Most hardware and software products in our company come from two or more vendors. | 3.92 | 3.75 |
| B | Our computer systems enable us to have ample freedom in choosing suppliers. | 3.77 | 2.75 |
| C | Increasing our choice of hardware and software suppliers will result in improved price and performance of computer products. | 4.13 | 3.75 |
| D | Availability of hardware and software products will result in more choices at more competitive prices. | 4.10 | 4.5 |

TABLE 1 AVAILABILITY

As shown in Table 1, the private sector ranking of importance for these statements to OSE technology is statements C, D, A, and B. For the Army, statements D, C, A, and B are the ranking order in regards to importance. It is noticed that both the private sector and the Army ranked statements D and C as the top two statements in this section with several scores exceeding "4" on the Likert response scale. This ranking can be attributed to the issue that OSE technology promises to afford IS users with more choices of computer products at more competitive prices. Also, both groups ranked statement B as the least important. In analyzing these two mean scores, the private sector's score leads the Army score by 1.02 ($3.77 - 2.75$). This difference in mean scores is the largest throughout this section. Further, the writer observed that the Army

had a mean score of "4.5" for statement D. This score is an indication that the "price" of computer products is a strong concern for the Army. Also, this score for statement D could be an indicator of the traditional government procurement trend to value "price over performance."

| Statement | Description of the Statements | Private | ISM |
|-----------|--|---------|------|
| A | Our computer systems enable information to move freely across dissimilar hardware platforms. | 3.41 | 2.75 |
| B | Our computer systems provide us with the ability to exchange data between different vendors applications and operating systems. | 3.56 | 3.0 |
| C | Our computer systems can be connected to equipment from multiple vendors easily and quickly with minimal staff at minimal expense. | 3.0 | 2.5 |
| D | Our computer system is compatible with an Unix-based network. | 3.25 | 3.75 |

TABLE 2 INTEROPERABILITY

Table 2 overall mean scores for both the private sector and the Army indicate a neutral position concerning interoperability. According to several leading companies in OSE technology, interoperability is the most critical factor to OSE technology because it enables data to move across different types of computer environments. The responses in Table 2 indicate that more research is necessary in OSE technology to develop a standard that maximizes the benefits associated with interoperability.

In observing the mean scores for statement A of this section, the writer noticed that the Army lagged the private sector by .66 (3.41 - 2.75). This difference in mean scores is the largest throughout the section. Further, both the private sector and Army mean scores for statement C were the lowest throughout this section. These responses are clear indications that more research is necessary in OSE technology to provide IS users with the benefits of improved performance of computer products and lower information technology cost.

| Statement | Description of the Statement | Private | ISM |
|-----------|---|---------|------|
| A | Our computer systems have the ability to use application software across multiple vendors hardware. | 3.36 | 3.0 |
| B | Our computer systems provide ease of networking and data exchange among applications. | 3.51 | 2.75 |
| C | The operating system of our computers is compatible with an Unix-based network. | 3.11 | 3.5 |

TABLE 3 PORTABILITY

The mean scores in Table 3 for the private sector and the Army concerning portability also indicate neutral positions. Also, the leading companies in OSE technology that participated in the survey stated that portability is the second most critical factor to OSE technology. The rationale for this statement is that portability provides

an IS user with the ability to use application software across different vendor hardware and operating systems. Further, the responses in Table 3 also are another indication that more research is necessary for developing OSE standards that maximize the benefits associated with portability.

In analyzing the data for portability, the writer observed that the Army mean score for statement B lagged the private sector by .76 (3.51 - 2.75). This difference in mean score is the largest throughout this section. Further, statement B is the private sector's highest mean score for portability. However, the Army's lowest mean score in this section is the response to statement B.

| Statement | Description of the Statement | Private | ISM |
|-----------|---|---------|-----|
| A | Our computer systems provide the capability to move applications off mainframes to smaller systems. | 3.36 | 4.0 |
| B | Our computer systems provide the capability to move applications off smaller systems to mainframes. | 2.72 | 3.5 |

TABLE 4 SCALABILITY

Table 4 indicates that the Army leads the private sector in scalability. The Army leads the private sector by .64 (4.0 - 3.36) and .78 (3.5 - 2.72) for statements A and B, respectively. The OSF organization, as quoted by the DMR Group (1990), stated that scalability provides IS

users with the ability to use the same software environment on many classes of computers, from personal computers to supercomputers. Noteworthy, majority of the surveyed companies that are members of COS, X/OPEN, and OSF organizations believe that scalability has a low priority within OSE technology. Therefore, these companies are conducting minimum research concerning scalability in developing OSE standards. This occurrence may result in a shortcoming for the ISM since the Army plans to incorporate scalability as a high priority in the implementation strategy of the system.

FINDINGS OF THE STUDY

Listed below are the key survey findings discovered during this study of comparing the ISM with the private sector's standard information system that operates within an OSE.

1. **OSE Technology.** Section 1 (General Information), Question 3 of the questionnaire indicated that the trend of computer and information technologies in the private sector is moving to open systems. The survey findings indicated that 39 (80%) of the 49 surveyed companies were migrating

to OSE technology. The other 10 companies (20%) elected to remain with proprietary information systems. Since the ISM is an information system that is being implemented with OSE technology, this implementation strategy indicates that the Army is moving in the same direction as the private sector concerning the latest trend in computer and information technologies.

2. Availability. Statement B, Section 2 of the questionnaire, indicated that the Army mean score lagged the private sector score by 1.02. This difference is not statistically significant, however, this trend should be corrected. Implementing the ISM with a strategy that increases the number of qualified vendors into the government procurement process should result in better competition and more economical hardware and software products. Further, the Army response to statement D (mean score of 4.5) of this section clearly indicates that competitive pricing is a top concern.

3. Interoperability. Statement A, Section 3 of the questionnaire indicated that the Army mean score lagged the private sector score by .66. Even though the difference of .66 is not statistically significant, this shortcoming should be corrected immediately to remain abreast with the

leading companies in open systems stated that interoperability is the most critical factor to OSE technology. With minimum interoperability, the ISM may not be implemented with the capability to efficiently exchange data across dissimilar hardware platforms. Also, this shortcoming could result in the forfeiture of future savings in computer equipment cost, manpower, and the opportunity to streamline installation management.

4. Portability. Statement B, Section 4, indicated that the Army mean score lagged the private sector score by .76. Again, this difference is not statistically significant but it should be corrected promptly to remain abreast with the private sector concerning portability. Additionally, protability was identified as the second most critical factor in OSE technology by several leading companies in open systems. With minimum portability, the ISM may be implemented with an inefficient method for installation organizations to horizontal and vertical share information to efficiently manage its resources. Thus, this shortcoming could result in the Army to forfeit the opportunity to streamline installation management.

5. Scalability. Statement A and B, Section 5, revealed that the Army mean score was higher than the private sector

concerning scalability. This achievement is an excellent benefit for the Army to implement the ISM with the ability to move an application onto hardware (i.e. personal computers, mainframes, etc.) with a variety of performance characteristics. However, many leading companies of OSE technology have stated that scalability has a low priority in developing a standard for open systems. To offset this shortcoming, the Army may need to influence (i.e. research incentives, joint venture research, etc.) industry to emphasize scalability in the development of open systems standards.

RECOMMENDATIONS FOR IMPLEMENTATION

The writer addressed the problem area with four recommendations as a result of the findings of the survey. The findings indicated that each section of the survey had a shortcoming that should be corrected. To improve the ISM posture with the private sector, the writer recommends that the four solutions listed below be implemented.

1. **Section 2 (Availability).** Revise request for proposal (RFP) procedures to ensure that vendors hardware and software products comply with the Government Open Systems Interconnection Profile (GOSIP) and Portable Operating

System Interface for Computer Environment (POSIX) standards.

2. Section 3 (Interoperability). Revise the U.S. Army Information Systems Engineering Command (USAISEC) network configuration for the ISM.

3. Section 4 (Portability). Implement the Distributed Computer and Data network to enhance data sharing among installation organizations.

4. Section 5 (Scalability). Specify scalability as a performance requirement in the RFP for the vendors' hardware and software products.

Implementation Plan

The writer conducted telephone interviews with several surveyed companies and DOIM's to determine the priority for implementing each solution based upon its importance to OSE technology. Upon the completion of the interviews, the rand order for implementing the solutions according to the responses were: Interoperability, Portability, Scalability, and Availability.

1. Interoperability. Revise the USAISEC network configuration plan for the ISM.

According to several DOIM's, the USAISEC network configuration plan does not promote interoperability within

the ISM. With this drawback, information does not move freely across dissimilar hardware platforms when using the ISM in a network configuration. Revising the plan to incorporate a standard communication protocol (OSI) across the different vendor platforms will greatly increase the potential for interoperability with comparable open systems. Therefore, installation organizations will have the capability to interface and transfer data to other organizations located on different military installations throughout the Army. For example, when a soldier changes duty station, installation organizations need the capability to electronically transfer his/her records to the gaining installation. With the ISM using a standard protocol, such as OSI, this task can be successfully completed. Additionally, the writer recommends that USAISEC periodically survey various DOIM's to verify the effectiveness of its network configuration. Periodic surveys will provide USAISEC with information to identify if the network plan is meeting the current data communications requirements.

2. Portability. Implement a distributed computer and data network and USAISEC centralized computer network to enhance data sharing among installation organizations.

According to the DOIM's, the ISM implementation strategy hinders ease of networking and data exchange among applications. Several DOIM's also indicated that the network of information designed for the ISM should be revised to promote data exchange using the ISM. The current network, USAISEC centralized computer model, is comprised of an Army Information Processing Center (AIPC). The AIPC regulates data processing and communications in a network when the ISM is used for data sharing among installation organizations. Frequently, installation organizations cannot exchange data among each other because data transfer of the information may not be permitted at the AIPC. Two of the common reasons that may be contributors to the data transfer drawback are: differences in the operating systems protocols for the AIPC and the user (installation organizations) of ISM and/or lack of available data communications lines available to access the AIPC. However, if the Army change the network to a Distributed computer and data model, data exchange among the users can be significantly improved. This network structure is comprised of a Stored Forward Area (SFA) which only stores and routes data. Therefore, information can be easier exchange among the users since it

is not being regulated by a centralized processing structure. Also, the Army should implement a network policy to ensure that both the users, SFA's and AIPC's are using the same communications protocol.

3. Scalability. Specify scalability as a performance requirement in the RFP for the vendors' hardware and software products.

The findings of the survey indicated that the forerunners in OSE technology have placed minimum priority on scalability in developing standards in open systems. However, the implementation strategy for the ISM requires that scalability be a high priority in data processing. In order to acquire hardware and software products with a suitable degree of scalability for the ISM, the Army must ensure that the RFP require vendors to meet the scalable performance criteria listed in the ISM-TEMP. The criteria must measure vendors products to ensure that the users of ISM have the capability to use applications on machines with various performance characteristics. Therefore, users can select the optimal configuration for a given situation.

4. Availability. Revise RFP procedures to ensure that vendors hardware and software products comply with GOSIP and POSIX standards.

requirement in the request for proposal (RFP) for the vendors' hardware and software products.

The findings of the survey indicated that the forerunners in OSE technology have placed minimum priority on scalability in developing standards in open systems. However, the implementation strategy for the ISM requires that scalability be a high priority in data processing. In order to acquire hardware and software products with a suitable degree of scalability for the ISM, the Army must ensure that the RFP require vendors to meet the scalable performance criteria listed in the ISM-TEMP. The criteria must measure vendors' products to ensure that the users of ISM have the capability to use applications on machines with various performance characteristics. Therefore, users can select the optimal configuration for a given situation.

4. Availability. Revise the equipment purchase procedures to ensure that vendors hardware and software products comply with GOSIP and POSIX standards.

According to the Competition and Contracting Act, the Army does not have the freedom to choose suppliers like the private sector. However, if the Army specify in its purchasing procedures that vendors' products must comply with GOSIP and POSIX standards, industry would be influence

to develop computer products that meets the government open systems requirements.

GOSIP and POSIX are standards used by federal government agencies that define and describe a common set of data communications protocols. These protocols enable systems developed by different vendors to interoperate and users of different applications for these systems to exchange information. Implementing GOSIP and POSIX will enable small and mid-size vendors to develop and market open systems products competitively in the presence of larger vendors. With a larger number of vendors entering the competitive procurement process, prices for computer products should improved. Also, this factor will be particularly important if a follow-on procurement is necessary to extend the ISM infrastructure in the future.

Final Summary and Evaluation

In summary, the analysis of the ISM revealed several important issues. They are: (1) the Army is moving with industry in technology, (2) the network configuration may not maximize ISM performance in OSE technology, and (3) ISM performance for scalability may be significantly impacted

by industry's OSE priorities.

Traditionally, the military has been criticized by the public for performing its non-combat missions with outdated technology. However, with the implementation of ISM, the military has the opportunity to change the public perception concerning this issue. The ISM is a clear indication that the Army is beginning to move with industry to remain abreast with technology.

Second, the survey results indicated that ISM lags the private sector in interoperability and portability. These two elements of OSE are extremely critical for maximizing the benefits of open systems. According to several DOIM's, they believe that the network configuration for the ISM is a significant contributor for the system performing lower than the private sector's OSE systems. Therefore, it may be necessary that the Army investigate the configuration to determine if it maximizes or hinders the ISM performance concerning interoperability and portability.

Third, the writer discovered that the Army requires a high degree of scalability in the ISM to perform installation management. However, scalability is a low priority in the private sector. This variation in the priority of scalability may impact ISM performance since

hardware and software products may be developed with a low degree of scalable capability. Therefore, it is necessary that the Army influence industry to emphasize scalability in information and computer technologies or ensure that vendors' products perform in accordance with the ISM-TEMP.

In view of the limitations associated with this study, the findings and recommendations should be use as basis for follow-on research. Additional research could involved a larger sampling of the private sector and DOIM's to determine if the study findings represent the entire population of IS users. Until the additional research is conducted, these recommendations should be used as a guide to complete the developmental phase of the ISM.

Finally, the writer discovered why it is important for the Army to remain abreast with the private sector concerning technology. The data analysis for the survey indicated that the Army many forfeit the opportunity to realize savings in expenditure of resources and streamline the management of resources on military installations. However, realizing this opportunity will align the Army with DOD's goal of reducing defense spending and efficiently and effectively manage military installations.

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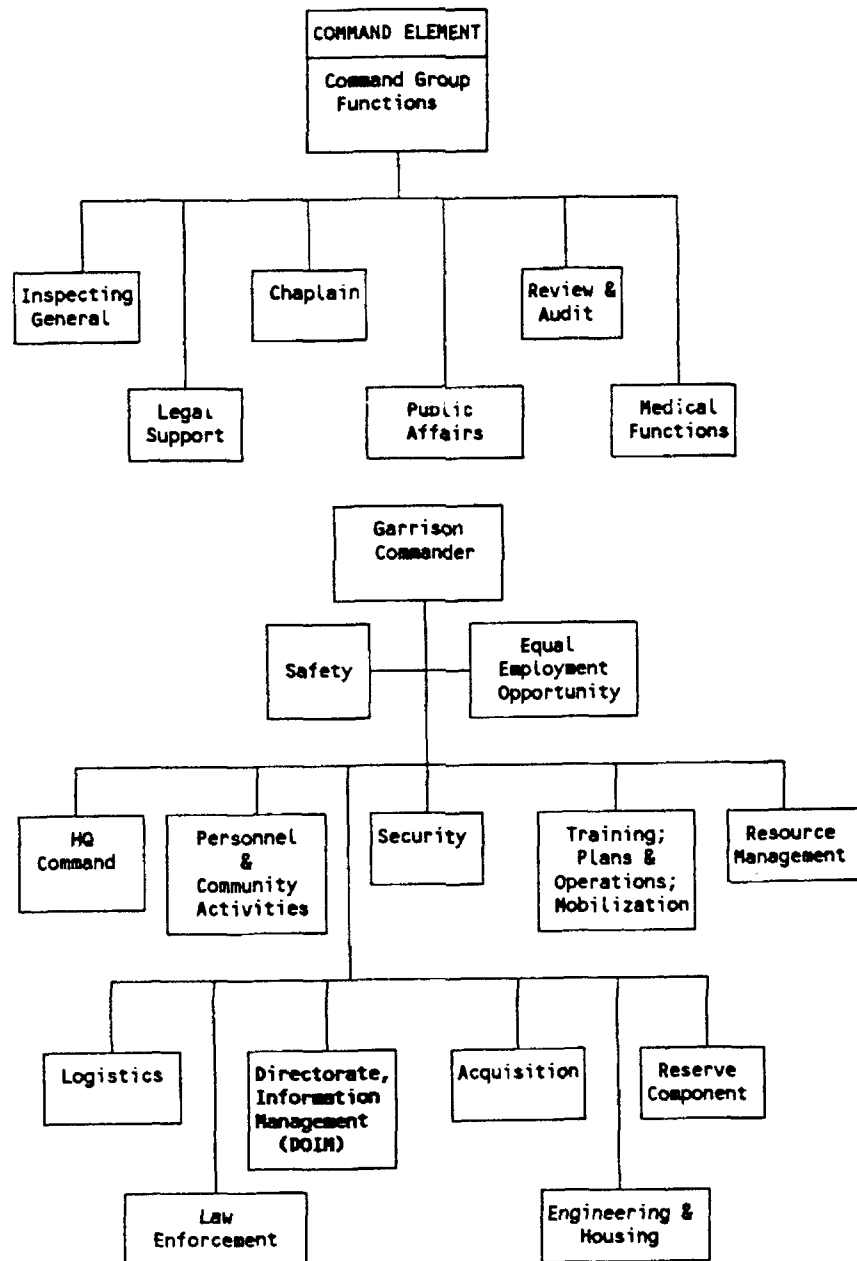
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Appendix A

(Standard Installation Organization Diagram)



Appendix B
(Cover Letter)

Dear Sir/Madam:

I am a graduate student at the University of Maryland working on my thesis titled "Analysis of the Army's Installation Support Modules (ISM) with the Private Sector's Information Management Systems". The purpose of my thesis is to compare the ISM (U.S. Army newest information management system) with the private sector's standard for information systems that operates in an Open Systems Environment (OSE). The ISM system is a computer hardware, software, and communications infrastructure designed to provide Army installations with an integrated information management capability for installation management.

Currently, I am conducting a survey to obtain information to determine if the implementation strategy for the ISM will maximize the benefits of OSE technology. I would appreciate your assistance by promptly completing the enclosed survey. Your responses to every question are important to the success of this study. Upon completion, please return the survey in the enclosed self-addressed stamped envelope by March 10, 1993. If you have any questions, please call the undersigned immediately at 301-498-6917. Thank you in advance for your consideration and cooperation in completing this survey.

Sincerely,

Paul G. Andrews
Captain, Signal Corps
U.S. Army

Appendix B (Con't)

OPFN SYSTEMS TECHNOLOGY SURVEY
(ISM and Private Sector)

DEFINITIONS

Listed below are terms frequently used in this survey. To insure consistency, please read the following definitions.

| TERMS | DEFINITIONS |
|------------------|--|
| Availability | The capability to acquire hardware and software for a computer system within the marketplace. |
| Computer System | A collection of components consisting of processors, operating systems, languages, communications, basic storage, and terminals. |
| Interoperability | The ability to have computers that are supplied by different vendors to operate together the in same network and share processes and data. |
| Open Systems | Vendor-independent computing environment consisting of commonly available computer products that have been designed and implemented in accordance with accepted non-proprietary standards. |

Appendix B (Con't)

(Definitions)

| | |
|-------------|--|
| Portability | The ability to use software applications across different types (multiple vendors) of computer hardware. |
| Scalability | The capability to use the same software environment on many classes of computers, from personal computers to supercomputers. |
| Unix-based | An operating system with the features and characteristics that are compatible with the Unix operating system. |

Appendix B (Con't)

OPEN SYSTEMS TECHNOLOGY QUESTIONNAIRE

Section 1

This section focuses on general information concerning your company.

1. Circle the main type(s) of business conducted in your company?
 - a. Agriculture
 - b. Manufacturing (Process: i.e. Paper products, wood products, etc.)
 - c. Manufacturing (Discrete: i.e. Industrial equipment, electronic equipment, etc.)
 - d. Transportation
 - e. Communications
 - f. Retail
 - g. Bank/Savings & Loans
 - h. Utilities
 - i. Finance/Insurance
 - j. Legal services
 - k. Personal services (i.e. Lodging, Amusement & Recreational services, etc.)
 - l. Education
 - m. Federal government (i.e. military, DOD agencies, etc.)
 - n. State/Local government
 - o. Engineering/Management
 - p. Other _____
2. Does your company have membership in any of the following organizations? Yes ___ No ___
(If Yes, check all that apply.)
 - a. Corporation of Open Systems (COS)
 - b. X/Open Incorporation (X/OPEN)
 - c. Open Systems Foundation (OSF)
3. Is your company currently implementing an open systems strategy? Yes ___ No ___

Appendix B (Con't)

4. Which of these operating environments are currently included in your open systems strategy? (Check all that apply.)

| | | |
|-----------------------------------|--|------------------------------------|
| <input type="checkbox"/> MS DOS | <input type="checkbox"/> Microsoft Windows | <input type="checkbox"/> X/Windows |
| <input type="checkbox"/> OS/2 | <input type="checkbox"/> AT&T UNIX | <input type="checkbox"/> MVS |
| <input type="checkbox"/> AIX | <input type="checkbox"/> VMS | <input type="checkbox"/> OSF/1 |
| <input type="checkbox"/> SCO UNIX | <input type="checkbox"/> Novell Netware | <input type="checkbox"/> UNIXWARE |
| <input type="checkbox"/> HP/UX | <input type="checkbox"/> LAN Manager | <input type="checkbox"/> Other |
| | | <input type="checkbox"/> |
| | | <input type="checkbox"/> |

INSTRUCTIONS FOR SECTIONS 2, 3, 4, & 5

Indicate the degree of agreement or disagreement which you personally believe about each of the following statements. Circle the number which most closely reflects your belief in each of the statements. The response scale ranges from 1 to 5 (**NOTE:** "1" indicates strongly disagree; "2" indicates disagree; "3" indicates neutral; "4" indicates agree, and "5" indicates strongly agree).

Section 2 (Availability)

| STATEMENTS | RESPONSE |
|---|-----------|
| A. Most hardware and software products in our company come from two or more vendors. | 1 2 3 4 5 |
| B. Our computer systems enable us to have ample freedom in choosing suppliers. | 1 2 3 4 5 |
| C. Increasing our choice of hardware and software suppliers will result in improved price and performance of computer products. | 1 2 3 4 5 |
| D. Availability of hardware and software products will result in more choices at more competitive prices. | 1 2 3 4 5 |

Appendix B (Con't)

Section 3 (Interoperability)

| STATEMENTS | RESPONSE |
|--|-----------|
| A. Our computer systems enable information to move freely across dissimilar hardware platforms. | 1 2 3 4 5 |
| B. Our computer systems provide us with the ability to exchange data between different vendors applications and operating systems. | 1 2 3 4 5 |
| C. Our computer systems can be connected to equipment from multiple vendors easily and quickly with minimal staff, at minimal expense. | 1 2 3 4 5 |
| D. Our computer system is compatible with an Unix-based network. | 1 2 3 4 5 |

Section 4 (Portability)

| STATEMENTS | RESPONSE |
|--|-----------|
| A. Our computer systems have the ability to use application software across multiple vendors hardware. | 1 2 3 4 5 |
| B. Our computer systems provide ease of networking and data exchange among applications. | 1 2 3 4 5 |
| C. The operating system of our computers is compatible with an Unix-based network. | 1 2 3 4 5 |

Appendix B (Con't)

Section 5 (Scalability)

| STATEMENTS | RESPONSE | | | | |
|--|----------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| A. Our computer systems provide the capability to move applications off mainframes to smaller systems. | | | | | |
| B. Our computer systems provide the capability to move applications off smaller systems to mainframes. | | | | | |

Section 6 (General Open Systems Information)

Indicate your views concerning issues relating to Open Systems by responding to the questions below.
(Please Print)

- A. In your own words, what are the benefits of Open Systems?
- B. In your own words, what are the drawbacks of Open Systems?

Appendix B (Con't)

(Continuation of Section 6)

- C. To the best of your knowledge, what companies are setting the directions in products and standards in the Open Systems marketplace?

BUSINESS INFORMATION (Please Print)

Your name _____ Title _____

Department _____

Company _____

Address _____

City _____ State _____ Zip Code _____

Telephone (____) _____

Appendix C

(List of Surveyed Companies and Director of Information
Management [DOIM's])

1. Miller Brewing Company
2. Quaker Oats Company
3. GIANT'S Food Corporation
4. Steak & ALE Restaurant Corporation
5. G. Heileman Brewing Company
6. HRB Systems
7. Coca-Cola Enterprises
8. St. Mary College of Maryland Library
9. Westinghouse Electric Corporation
10. Northrop Corporation
11. SAIC (Science Application International Corporation)
12. Delta Airlines
13. AARP (American Association of Retired Persons)
14. Digital Equipment Corporation
15. Federal Express
16. GTE Service Corporation
17. Samuel U. Rodgers Health Center
18. General Mills, Inc.
19. IBM Corporation

Appendix C (Con't)

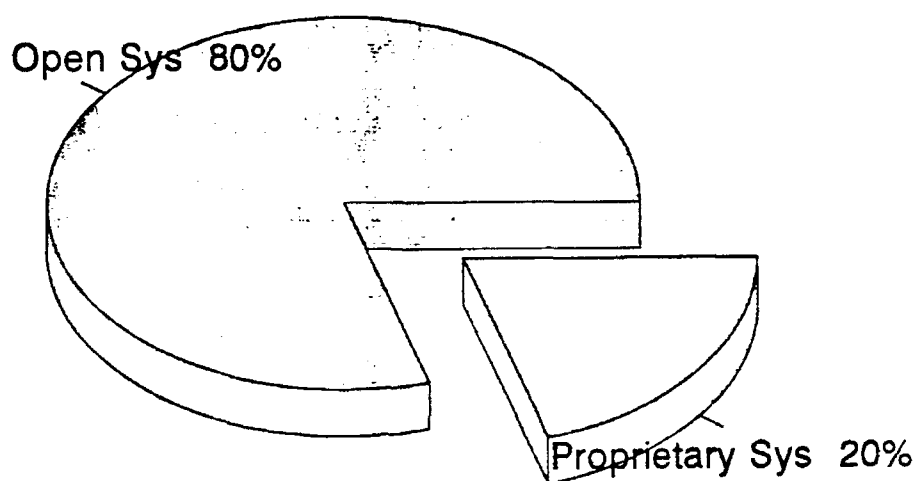
20. Four Seasons Hotel, Limited
21. Fairchild Space & Defense
22. Residential Service Corporation of America
23. Holy Cross Hospital
24. Coleman Research Corporation
25. Harris Corporation
26. Marriott Family Restaurants
27. MCI Corporation
28. OAO Corporation
29. Holiday Inn
30. John Hopkins University
31. Washington, DC Ramada Renaissance Hotel
32. Bell Atlantic Company
33. General Motors Corporations
34. AT&T
35. USAA Federal Savings Bank
36. Loral Western Development Laboratories
37. WTLA-TV, Washington, DC
38. Black Entertainment Television (BET)
39. Pacific Software Group
40. General Electric Aerospace

Appendix C (Con't)

41. Andersen Consulting
42. IIT Research, Inc.
43. Microsoft Corporation
44. Borland International
45. INA COM (Sears Federal Systems)
46. Blue Cross & Blue Shield of Maryland
47. Unisys Corporation
48. Potomac Electric Power Company (PEPCO)
49. Motorola Computer Group
50. DOIM (Fort Carson, CO)
51. DOIM (Fort Meade, MD)
52. DOIM (Military District of Washington [Fort McNair])
53. DOIM (Fort Polk, LA)

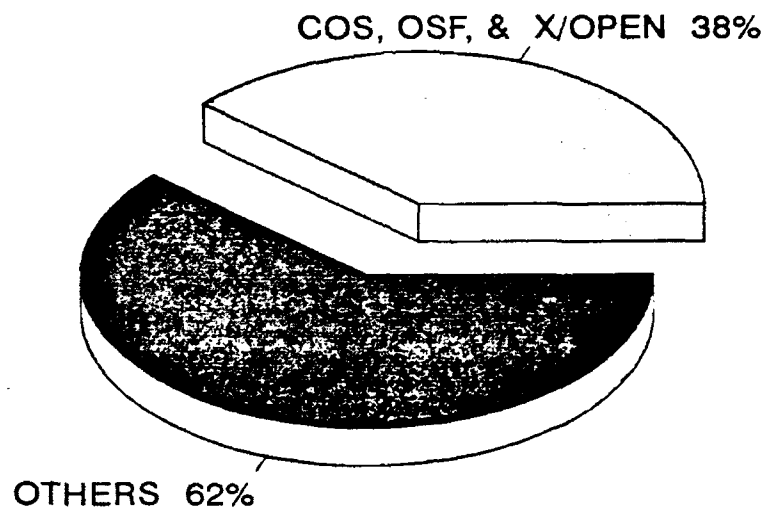
Appendix D

(Survey Results of Open & Proprietary IS users)



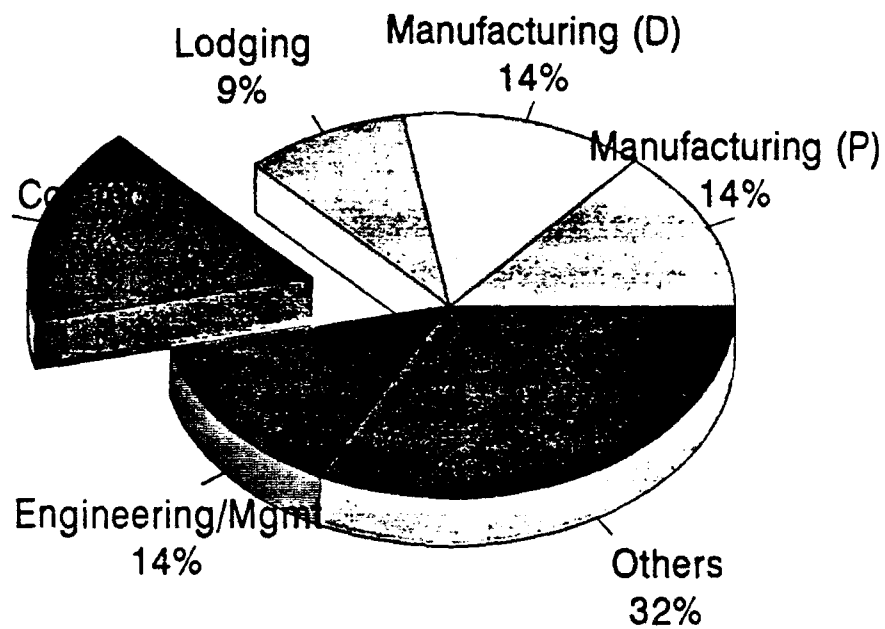
Appendix E

(Survey Results of Open IS users [COS, OSF, & X/OPEN])



Appendix F

(Survey Results of Industries surveyed)



Appendix G

(Questionnaire Responses from Proprietary IS users)

| COMPANY S's | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | MEAN SCORE FOR STATEMENT |
|-----------------------------------|---|---|---|---|---|---|---|---|---|----|--------------------------|
| SECTION 2 AVAILABILITY | | | | | | | | | | | |
| STATEMENT A | 5 | 1 | 5 | 5 | 4 | 5 | 3 | 1 | 5 | 5 | 3.9 |
| STATEMENT B | 4 | 1 | 4 | 3 | 4 | 4 | 4 | 4 | 3 | 3 | 3.4 |
| STATEMENT C | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 5 | 4.4 |
| STATEMENT D | 5 | 5 | 4 | 4 | 4 | 5 | 3 | 3 | 5 | 5 | 4.3 |
| SECTION 3 INTEROPERABILITY | | | | | | | | | | | |
| STATEMENT A | 2 | 4 | 2 | 2 | 4 | 3 | 4 | 5 | 3 | 4 | 3.3 |
| STATEMENT B | 2 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 4 | 4 | 3.6 |
| STATEMENT C | 3 | 1 | 2 | 2 | 4 | 3 | 3 | 1 | 4 | 5 | 2.8 |
| STATEMENT D | 2 | 1 | 2 | 2 | 4 | 4 | 3 | 5 | 4 | 5 | 3.2 |
| SECTION 4 PORTABILITY | | | | | | | | | | | |
| STATEMENT A | 4 | 2 | 2 | 3 | 4 | 3 | 3 | 5 | 4 | 5 | 3.5 |
| STATEMENT B | 4 | 2 | 4 | 3 | 4 | 4 | 4 | 3 | 4 | 5 | 3.7 |
| STATEMENT C | 2 | 1 | 4 | 2 | 4 | 3 | 3 | 5 | 4 | 5 | 3.3 |
| SECTION 5 SCALABILITY | | | | | | | | | | | |
| STATEMENT A | 1 | 3 | 2 | 2 | 4 | 2 | 4 | 4 | 2 | 5 | 2.9 |
| STATEMENT B | 2 | 2 | 2 | 2 | 4 | 4 | 2 | 4 | 2 | 5 | 2.9 |

Appendix H

(Responses from the Private Sector Open IS users)

| COMPANY # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 | 560 | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 | 577 | 578 | 579 | 580 | 581 | 582 | 583 | 584 | 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 | 617 | 618 | 619 | 620 | 621 | 622 | 623 | 624 | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 | 641 | 642 | 643 | 644 | 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 | 698 | 699 | 700 | 701 | 702 | 703 | 704 | 705 | 706 | 707 | 708 | 709 | 710 | 711 | 712 | 713 | 714 | 715 | 716 | 717 | 718 | 719 | 720 | 721 | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 | 734 | 735 | 736 | 737 | 738 | 739 | 740 | 741 | 742 | 743 | 744 | 745 | 746 | 747 | 748 | 749 | 750 | 751 | 752 | 753 | 754 | 755 | 756 | 757 | 758 | 759 | 760 | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769 | 770 | 771 | 772 | 773 | 774 | 775 | 776 | 777 | 778 | 779 | 780 | 781 | 782 | 783 | 784 | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 | 796 | 797 | 798 | 799 | 800 | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810 | 811 | 812 | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821 | 822 | 823 | 824 | 825 | 826 | 827 | 828 | 829 | 830 | 831 | 832 | 833 | 834 | 835 | 836 | 837 | 838 | 839 | 840 | 841 | 842 | 843 | 844 | 845 | 846 | 847 | 848 | 849 | 850 | 851 | 852 | 853 | 854 | 855 | 856 | 857 | 858 | 859 | 860 | 861 | 862 | 863 | 864 | 865 | 866 | 867 | 868 | 869 | 870 | 871 | 872 | 873 | 874 | 875 | 876 | 877 | 878 | 879 | 880 | 881 | 882 | 883 | 884 | 885 | 886 | 887 | 888 | 889 | 890 | 891 | 892 | 893 | 894 | 895 | 896 | 897 | 898 | 899 | 900 | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 | 909 | 910 | 911 | 912 | 913 | 914 | 915 | 916 | 917 | 918 | 919 | 920 | 921 | 922 | 923 | 924 | 925 | 926 | 927 | 928 | 929 | 930 | 931 | 932 | 933 | 934 | 935 | 936 | 937 | 938 | 939 | 940 | 941 | 942 | 943 | 944 | 945 | 946 | 947 | 948 | 949 | 950 | 951 | 952 | 953 | 954 | 955 | 956 | 957 | 958 | 959 | 960 | 961 | 962 | 963 | 964 | 965 | 966 | 967 | 968 | 969 | 970 | 971 | 972 | 973 | 974 | 975 | 976 | 977 | 978 | 979 | 980 | 981 | 982 | 983 | 984 | 985 | 986 | 987 | 988 | 989 | 990 | 991 | 992 | 993 | 994 | 995 | 996 | 997 | 998 | 999 | 1000 | 1001 | 1002 | 1003 | 1004 | 1005 | 1006 | 1007 | 1008 | 1009 | 1010 | 1011 | 1012 | 1013 | 1014 | 1015 | 1016 | 1017 | 1018 | 1019 | 1020 | 1021 | 1022 | 1023 | 1024 | 1025 | 1026 | 1027 | 1028 | 1029 | 1030 | 1031 | 1032 | 1033 | 1034 | 1035 | 1036 | 1037 | 1038 | 1039 | 1040 | 1041 | 1042 | 1043 | 1044 | 1045 | 1046 | 1047 | 1048 | 1049 | 1050 | 1051 | 1052 | 1053 | 1054 | 1055 | 1056 | 1057 | 1058 | 1059 | 1060 | 1061 | 1062 | 1063 | 1064 | 1065 | 1066 | 1067 | 1068 | 1069 | 1070 | 1071 | 1072 | 1073 | 1074 | 1075 | 1076 | 1077 | 1078 | 1079 | 1080 | 1081 | 1082 | 1083 | 1084 | 1085 | 1086 | 1087 | 1088 | 1089 | 1090 | 1091 | 1092 | 1093 | 1094 | 1095 | 1096 | 1097 | 1098 | 1099 | 1100 | 1101 | 1102 | 1103 | 1104 | 1105 | 1106 | 1107 | 1108 | 1109 | 1110 | 1111 | 1112 | 1113 | 1114 | 1115 | 1116 | 1117 | 1118 | 1119 | 1120 | 1121 | 1122 | 1123 | 1124 | 1125 | 1126 | 1127 | 1128 | 1129 | 1130 | 1131 | 1132 | 1133 | 1134 | 1135 | 1136 | 1137 | 1138 | 1139 | 1140 | 1141 | 1142 | 1143 | 1144 | 1145 | 1146 | 1147 | 1148 | 1149 | 1150 | 1151 | 1152 | 1153 | 1154 | 1155 | 1156 | 1157 | 1158 | 1159 | 1160 | 1161 | 1162 | 1163 | 1164 | 1165 | 1166 | 1167 | 1168 | 1169 | 1170 | 1171 | 1172 | 1173 | 1174 | 1175 | 1176 | 1177 | 1178 | 1179 | 1180 | 1181 | 1182 | 1183 | 1184 | 1185 | 1186 | 1187 | 1188 | 1189 | 1190 | 1191 | 1192 | 1193 | 1194 | 1195 | 1196 | 1197 | 1198 | 1199 | 1200 | 1201 | 1202 | 1203 | 1204 | 1205 | 1206 | 1207 | 1208 | 1209 | 1210 | 1211 | 1212 | 1213 | 1214 | 1215 | 1216 | 1217 | 1218 | 1219 | 1220 | 1221 | 1222 | 1223 | 1224 | 1225 | 1226 | 1227 | 1228 | 1229 | 1230 | 1231 | 1232 | 1233 | 1234 | 1235 | 1236 | 1237 | 1238 | 1239 | 1240 | 1241 | 1242 | 1243 | 1244 | 1245 | 1246 | 1247 | 1248 | 1249 | 1250 | 1251 | 1252 | 1253 | 1254 | 1255 | 1256 | 1257 | 1258 | 1259 | 1260 | 1261 | 1262 | 1263 | 1264 | 1265 | 1266 | 1267 | 1268 | 1269 | 1270 | 1271 | 1272 | 1273 | 1274 | 1275 | 1276 | 1277 | 1278 | 1279 | 1280 | 1281 | 1282 | 1283 | 1284 | 1285 | 1286 | 1287 | 1288 | 1289 | 1290 | 1291 | 1292 | 1293 | 1294 | 1295 | 1296 | 1297 | 1298 | 1299 | 1300 | 1301 | 1302 | 1303 | 1304 | 1305 | 1306 | 1307 | 1308 | 1309 | 1310 | 1311 | 1312 | 1313 | 1314 | 1315 | 1316 | 1317 | 1318 | 1319 | 1320 | 1321 | 1322 | 1323 | 1324 | 1325 | 1326 | 1327 | 1328 | 1329 | 1330 | 1331 | 1332 | 1333 | 1334 | 1335 | 1336 | 1337 | 1338 | 1339 | 1340 | 1341 | 1342 | 1343 | 1344 | 1345 | 1346 | 1347 | 1348 | 1349 | 1350 | 1351 | 1352 | 1353 | 1354 | 1355 | 1356 | 1357 | 1358 | 1359 | 1360 | 1361 | 1362 | 1363 | 1364 | 1365 | 1366 | 1367 | 1368 | 1369 | 1370 | 1371 | 1372 | 1373 | 1374 | 1375 | 1376 | 1377 | 1378 | 1379 | 1380 | 1381 | 1382 | 1383 | 1384 | 1385 | 1386 | 1387 | 1388 | 1389 | 1390 | 1391 | 1392 | 1393 | 1394 | 1395 | 1396 | 1397 | 1398 | 1399 | 1400 | 1401 | 1402 | 1403 | 1404 | 1405 | 1406 | 1407 | 1408 | 1409 | 1410 | 1411 | 1412 | 1413 | 1414 | 1415 | 1416 | 1417 | 1418 | 1419 | 1420 | 1421 | 1422 | 1423 | 1424 | 1425 | 1426 | 1427 | 1428 | 1429 | 1430 | 1431 | 1432 | 1433 | 1434 | 1435 | 1436 | 1437 | 1438 | 1439 | 1440 | 1441 | 1442 | 1443 | 1444 | 1445 | 1446 | 1447 | 1448 | 1449 | 1450 | 1451 | 1452 | 1453 | 1454 | 1455 | 1456 | 1457 | 1458 | 1459 | 1460 | 1461 | 1462 | 1463 | 1464 | 1465 | 1466 | 1467 | 1468 | 1469 | 1470 | 1471 | 1472 | 1473 | 1474 | 1475 | 1476 | 1477 | 1478 | 14 |
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Analysis of the Army's

68

Appendix I

(Questionnaire Responses from the Army [DOIM's] with ISM)

| ARMY ISM #S | 1 | 2 | 3 | 4 | MEAN SCORE PER STATEMENT |
|-------------------------|---|---|---|---|-----------------------------|
| SECTION 2 | | | | | |
| AVAILABILITY | | | | | |
| STATEMENT A | 5 | 5 | 1 | 4 | 3.75 |
| STATEMENT B | 3 | 5 | 1 | 2 | 2.75 |
| STATEMENT C | 5 | 4 | 3 | 3 | 3.75 |
| STATEMENT D | 6 | 4 | 5 | 4 | 4.5 |
| SECTION 3 | | | | | |
| INTEROPERABILITY | | | | | |
| STATEMENT A | 2 | 3 | 3 | 3 | 2.75 |
| STATEMENT B | 3 | 4 | 2 | 3 | 3 |
| STATEMENT C | 2 | 2 | 4 | 2 | 2.5 |
| STATEMENT D | 3 | 5 | 5 | 2 | 3.75 |
| SECTION 4 | | | | | |
| PORTABILITY | | | | | |
| STATEMENT A | 2 | 3 | 4 | 3 | 3 |
| STATEMENT B | 3 | 3 | 3 | 2 | 2.75 |
| STATEMENT C | 4 | 4 | 4 | 2 | 3.5 |
| SECTION 5 | | | | | |
| SCALABILITY | | | | | |
| STATEMENT A | 4 | 4 | 4 | 4 | 4 |
| STATEMENT B | 4 | 3 | 3 | 4 | 3.5 |